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10/581,601	06/05/2006	Masaru Sasaki	292134US26PCT	3608

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EXAMINER	
NIKMANESH, SEAHVOSH J	

ART UNIT	PAPER NUMBER
2812	

NOTIFICATION DATE	DELIVERY MODE
06/10/2009	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/581,601	SASAKI ET AL.	
	Examiner	Art Unit	
	SEAHVOSH J. NIKMANESH	2812	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *18 May 2009*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *22,25-31,35-37 and 39-42* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *22,25-31,35-37 and 39-42* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *05 June 2006* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *5/18/2009*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. This is in response to the IDS filed 5/18/2009.

Response to Arguments

2. Applicant's arguments, see pages 6-8 of the remarks, filed 3/12/2009, with respect to the rejection(s) of claim(s) 22 and 24-25 under 35 U.S.C. 102(b) have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of the 35 U.S.C. 103(a) rejections below.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 22 and 24-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sugawara et al., WO 2003/056622 further in view of Noguchi et al., US PGPub 2003/0001277 A1.

a. **Regarding to claim 22,** Sugawara et al. shows a method for cleaning a surface of a conductive layer on a semiconductor substrate placed in a reaction chamber, wherein plasma containing hydrogen and argon (page 5; i.e. inert gas) is generated in the reaction chamber, and the surface of the conductive layer is cleaned by being reduced therewith (Figs. 6A and 6B; and relevant text) and

that residual organic material on the surface of the conductive layer is ashed by the plasma (Pages 6, 10, and 11; i.e. sintering).

Sugawara et al., does not explicitly show that the inert gas is He.

Noguchi et al. teaches that it is desirable to use a mixed plasma including hydrogen, helium, and argon in plasma reduction processes ([0022]-[0023]).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the method as taught by Noguchi et al., with the method as shown by Sugawara et al., to have further used the helium gas along with the argon in plasma reduction processes with the motivation that helium is still an inert gas and serves as a diluting agent [0023]. The combination can be met with a reasonable expectation for success since the processes are related to plasma reduction and cleaning of dielectrics and metals using inert gases and hydrogen.

b. **Regarding claim 24,** Sugawara et al. shows that an insulating layer is formed on the surface of the conductive layer, a via hole for exposing a part of the conductive layer is formed in the insulating layer, and the surface of the conductive layer exposed through a bottom portion of the via hole is cleaned by the plasma (Page 12).

c. **Regarding claim 25,** Sugawara et al. shows that an upper insulating film is further formed on the insulating layer, and a wiring trench for exposing the via hole is formed in the upper insulating film, the exposed surface of the conductive

layer being cleaned by the plasma after the upper insulating film has been formed (Page 12).

d. **Regarding claim 26,** Sugawara et al. shows that the density of the plasma is 10^{10} to $10^{13}/cm^3$ (Fig. 5; Page 10).

e. **Regarding claim 27,** Sugawara et al. shows that the electron temperature of the plasma is 0.7 to 3 eV (Fig. 5; Page 10).

f. **Regarding claim 28,** Sugawara et al. shows that the electron temperature of the plasma is 0.7 to 3 eV (Fig. 5; Page 10).

g. **Regarding claim 29,** Sugawara et al. shows that the plasma is generated by using a planar antenna (Page 6).

h. **Regarding claim 30,** Sugawara et al. shows that the plasma is inductively coupled plasma or magnetron plasma (Pages 4-6 and 10).

i. **Regarding claim 31,** Sugawara et al. shows that the high density plasma processing is performed by forming a uniform electric field in the reaction chamber, the high density plasma being generated using microwave (Pages 5 and 6).

5. Claims 22, 24-25, 37, and 39-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takagi et al., US 6,174,796 B1 further in view of Noguchi et al., US PGPub 2003/0001277 A1.

a. **Regarding claim 22,** Takagi et al. shows a method for cleaning the surface of a conductive layer (5) on a semiconductor substrate (1) placed in a reaction chamber,

wherein plasma containing hydrogen and argon is generated in the reaction chamber, and the surface of the conductive layer is cleaned by being reduced therewith (Figs. 3D and 3E; Column 5, lines 16-33) and shows that residual organic material on the surface of the conductive layer is ashed by the plasma (Fig. 5; Column 5; lines 16-33).

Takagi et al., does not explicitly show that He is used.

Noguchi et al. teaches that it is desirable to use a mixed plasma including hydrogen, helium, and argon in plasma reduction processes ([0022]-[0023]).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the method as taught by Noguchi et al., with the method as shown by Takagi et al., to have further used the helium gas along with the argon in plasma reduction processes with the motivation that helium is still an inert gas and serves as a diluting agent [0023]. The combination can be met with a reasonable expectation for success since the processes are related to plasma reduction and cleaning of dielectrics and metals using inert gases and hydrogen.

b. **Regarding claim 24,** Takagi et al. shows that an insulating layer is formed on the surface of the conductive layer, a via hole for exposing a part of the

conductive layer is formed in the insulating layer, and the surface of the conductive layer exposed through a bottom portion of the via hole is cleaned by the plasma (Figs. 3D and 3E; Column 5, lines 16-33).

c. **Regarding claim 25,** Takagi et al. shows that an upper insulating film is further formed on the insulating layer, and a wiring trench for exposing the via hole is formed in the upper insulating film, the exposed surface of the conductive layer being cleaned by the plasma after the upper insulating film has been formed (Figs. 3D and 3E; Column 5, lines 16-33).

d. **Regarding claim 37,** Takagi et al. shows a storage medium storing software for performing a cleaning method for cleaning the surface of a conductive layer (5) on a semiconductor substrate (1) placed in a reaction chamber, wherein plasma containing hydrogen and argon is generated in the reaction chamber, and the surface of the conductive layer is cleaned by being reduced therewith (Figs. 3D and 3E; Column 5, lines 16-33) wherein a residual organic material on the surface of the conductive layer is ashed by the plasma (Fig. 5; Column 5; lines 16-33). . The examiner takes official notice that the method described by Takagi et al. above would be done by a system having a computer readable medium contained in the system RAM, ROM, Hard drive or CD, which when executed would perform the above process.

Takagi et al., does not explicitly show that He is used.

Noguchi et al. teaches that it is desirable to use a mixed plasma including

hydrogen, helium, and argon in plasma reduction processes ([0022]-[0023]).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the method as taught by Noguchi et al., with the method as shown by Takagi et al., to have further used the helium gas along with the argon in plasma reduction processes with the motivation that helium is still an inert gas and serves as a diluting agent [0023]. The combination can be met with a reasonable expectation for success since the processes are related to plasma reduction and cleaning of dielectrics and metals using inert gases and hydrogen.

e **Regarding claim 39,** Takagi et al. shows that the storage medium further encompasses the computer readable medium wherein an insulating layer is formed on the surface of the conductive layer, a via hole for exposing a part of the conductive layer is formed in the insulating layer, and the surface of the conductive layer exposed through a bottom portion of the via hole is cleaned by the plasma (Figs. 3D and 3E; Column 5, lines 16-33). The examiner takes official notice that the method described by Takagi et al. above would be done by a system having a computer readable medium contained in the system RAM, ROM, Hard drive or CD, which when executed would perform the above process.

f **Regarding claim 40,** Takagi et al. shows that the storage medium further encompasses the computer readable medium wherein an upper insulating film is

further formed on the insulating layer, and a wiring trench for exposing the via hole is formed in the upper insulating film, the exposed surface of the conductive layer being cleaned by the plasma after the upper insulating film has been formed (Figs. 3D and 3E; Column 5, lines 16-33). The examiner takes official notice that the method described by Takagi et al. above would be done by a system having a computer readable medium contained in the system RAM, ROM, Hard drive or CD, which when executed would perform the above process.

g **Regarding claim 41,** Takagi et al. shows that the storage medium further encompasses the computer readable medium wherein the cleaning is performed by a high density plasma processing at a low electron temperature, and the generating plasma is performed by forming a uniform electric field in the reaction chamber, a high density plasma being generated using microwave (Column 4, lines 32-44 and Column 5, lines 16-33). The examiner takes official notice that the method described by Takagi et al. above would be done by a system having a computer readable medium contained in the system RAM, ROM, Hard drive or CD, which when executed would perform the above process.

6. Claims 35, 36, and 42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takagi et al. US 6,174,796 in view of Noguchi et al., US PGPub

2003/0001277 A1 as applied to claims 22, 23, and 38, respectively, above, and further in view of Waldfried et al., US 6,630,406 B2.

a. **Regarding claim 35,** Takagi et al. in view Noguchi et al., of shows the invention as claimed pertaining to claim 22 above.

Takagi et al. in view of Noguchi et al., does not explicitly show that the process is performed under an atmosphere of a gaseous mixture containing hydrogen and helium, and flow ratio of the helium with respect to the hydrogen is set to be 0.005 to 20.

Waldfried et al. teaches that it is well know to conduct plasma ashing processes in an atmosphere of a gaseous mixture containing hydrogen and helium, and flow ratio of the helium with respect to the hydrogen is set to be 0.005 to 20 (Column 7, lines 13-31).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have further used the process as taught by Waldfried et al. with the combination of Takagi et al. in view of Noguchi et al., with the motivation that the helium molecules are light and readily diffuse to the substrate thus improving the carrier characteristics for plasma generated by hydrogen plasma (Column 4, lines 53-56). The combination can be met with a reasonable expectation for success since the teachings are related to the use of hydrogen plasma in the removal of residue in semiconductor interconnect fabrication.

b. **Regarding claim 36,** Takagi et al. in view Noguchi et al., shows the invention as claimed pertaining to claim 23 above.

Takagi et al. in view Noguchi et al., does not explicitly show that the process is performed under an atmosphere of a gaseous mixture containing hydrogen and helium, and flow ratio of the helium with respect to the hydrogen is set to be 0.005 to 20.

Waldfried et al. teaches that it is well know to conduct plasma ashing processes in an atmosphere of a gaseous mixture containing hydrogen and helium, and flow ratio of the helium with respect to the hydrogen is set to be 0.005 to 20 (Column 7, lines 13-31).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have further used the process as taught by Waldfried et al. with the combination of Takagi et al. in view of Noguchi et al., with the motivation that the helium molecules are light and readily diffuse to the substrate thus improving the carrier characteristics for plasma generated by hydrogen plasma (Column 4, lines 53-56). The combination can be met with a reasonable expectation for success since the teachings are related to the use of hydrogen plasma in the removal of residue in semiconductor interconnect fabrication.

c. **Regarding claim 42,** Takagi et al. in view Noguchi et al., shows the invention as claimed pertaining to claim 38 above.

Takagi et al. in view Noguchi et al., does not explicitly show that the process is performed under an atmosphere of a gaseous mixture containing hydrogen and helium, and flow ratio of the helium with respect to the hydrogen is set to be 0.005 to 20.

Waldfried et al. teaches that it is well know to conduct plasma ashing processes in an atmosphere of a gaseous mixture containing hydrogen and helium, and flow ratio of the helium with respect to the hydrogen is set to be 0.005 to 20 (Column 7, lines 13-31).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have further used the process as taught by Waldfried et al. with the combination of Takagi et al. in view of Noguchi et al., with the motivation that the helium molecules are light and readily diffuse to the substrate thus improving the carrier characteristics for plasma generated by hydrogen plasma (Column 4, lines 53-56). The combination can be met with a reasonable expectation for success since the teachings are related to the use of hydrogen plasma in the removal of residue in semiconductor interconnect fabrication. The examiner takes official notice that the combined method described by Takagi et al. in view of Noguchi et al., and Waldfried et al. above would be done by a system having a computer readable medium contained in the system RAM, ROM, Hard drive or CD, which when executed would perform the above process.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to SEAHVOSH J. NIKMANESH whose telephone number

is (571)270-1805. The examiner can normally be reached on Mon through Fri 7:30 - 5:00 E.S.T..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Charles Garber can be reached on 571-272-2194. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Seahvosh J Nikmanesh/
Examiner, Art Unit 2812

/Alexander G. Ghyka/
Primary Examiner, Art Unit 2812